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THE DESIGN OF MISNAY-SCHARDIN CHARGES

Cdr. P. BETHELL R.N.

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July, 1952

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ARMAMENT DESIGN ESTABLISHMENT

TECHNICAL REPORT

No. 6/52

THE DESIGN OF 'MISNAY-SCHARDIN' CHARGES

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Recommended for publication .

Approved for publication A. P. Wickens, C.E.A.D.

Abstract

Description of the principle whereby a cylindrical explosive charge may be made to fling off a steel terminal disc as a high-velocity projectile is given with possible applications in Service munitions. The parameters governing the proportions and design of such charges and the choice of high explosive are also included.

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July, 1952.

[redacted]

THE DESIGN OF "MISNAY-SCHARDIN" CHARGES

The Misnay-Schardin Effect

The Misnay-Schardin Effect can be simply illustrated by the following crude exemplification of it, which although not expressly tested, would probably work quite well. Suppose an ordinary cylindrical cocoa-tin be taken, and to the base of it a disc of the same size made from half-inch mild steel be affixed by solder or adhesive. Then if the tin be filled with cast T.N.T., and fitted with a detonator and exploder positioned axially at the lid end, on firing the detonator the steel disc will be flung off as a high velocity projectile, and with luck may be flung off intact.

Possible Applications

Clearly this principle lends itself readily to embodiment in several kinds of Service munitions. To begin with, a crude charge of the type described in the preceding paragraph, if actuated remotely or by a trip wire, could be made to serve as a powerful short-range expendable gun against tanks, vehicles, or soldiers; and munitions on this principle have in fact been designed and made by the French army authorities at Bourges. Again, a charge of this sort could be buried in the ground and made to act as an anti-tank mine which, with suitable fuzing, might be expected to penetrate the belly of a tank, and mines of this sort have also been designed in France. Similar charges could be made to serve as petards for blowing large holes in the walls of fortifications, and there is evidence that the insurgent forces have been using them for this in the war in Indo-China. Further, there is no reason why this kind of explosive charge should not be incorporated in the cavity of a shell, bomb, or other missile, fuzed in such a way that on impact the disc is flung through the armoured deck or structure of the target. A very ambitious application in this direction was the "C.S." (capital ship) aircraft bomb designed by Department M.D.1. of the Ministry of Defence in World War II and containing some 2,000 lb. of H.E. This was one of the earliest British applications, and an account of the trial of it is given in Reference (1).

Sources of Design Information

Although the aforesaid explosive phenomenon is widely known, it is, justly or unjustly, usually known in Britain as the "Misnay-Schardin effect", and when in 1952 some difficulties were being experienced with the design of suitable munitions on this principle at A.D.E., it was decided to apply to the source. A cursory study of the available literature indicated that there was no recent comprehensive guide to the design of munitions embodying this principle, though two reports written for the British Intelligence Objectives Sub-Committee by Dr. H. L. Porter of the Armament Research Establishment in 1946 contain a good deal of information under this head (References (2) and (3)). Mention may also be made of the theoretical treatment cited in Reference (4), which develops a method of predicting the velocity of projection of the disc or "slug". Misnay was a Hungarian army officer whose present whereabouts is unknown, and his co-worker in this field, Schardin, was a Berlin professor who for most of World War II was employed in the laboratory of ths Physics and Ballistics Institute established by the Luftministeriumat Berlin-Gatow. In 1946, the staff and equipment of this laboratory were transferred by the French to St. Louis (Haut Rhin), where under military superintendence Schardin acts as chief scisntist of the establishment. Permission was therefore obtained through the Military Attache (Technical) at H.B.M. Embassy Paris, to pay a visit to St. Louis for the express purpose of gleaning further information on ths design of Misnay-Schardin chargss.

In a recent internal A.D.E. report, Reference (5), an explanation is given as to why this visit was not wholly successful. For the purposes of the present paper it suffices to say that the French military controlling authorities at St. Louis do not like visitors to interrogate the German scientific staff, but prefer to try to answer all questions themselves. In the case of Misnay-Schardin explosive charges, it is believed that the French authorities have thoroughly understood the preoepts laid down by Professor Schardin, and a good reason for thinking so lies in the fact that they have taken a lively interest in this phenomenon and applied it in several designs of munitions, all of which they have tried out fairly intensively. It is nevertheless possible that ths information which follows may be at variance with Schardin's ideas in one respect or another, and ths possibility is mentioned as a warning. Infallibility is not claimsd.

Design Parameters of Misnay-Schardin Charges

1. Proportions

(a) For a charge which is intended to fling off the disc in one piece, elementary considsrations as to the sxpected conformation of the front of the detonation wave require that the disc should be a dish or saucer, concave when viewed from the target. Turning now to Fig. 1, the dish or saucer shown is of spherical form struck with a radius R. The length of the chord governing the size of the dish is D; then the first rule is that:

$$\underline{R = 1.5D \text{ approx.}} \qquad (1)$$

Alternatively, if the depth of dishing be denoted by d, then this is the same thing as saying that:

$$\underline{D = 12d \text{ approx.}} \qquad (2)$$

It will be noted that the geometry of the charge is really that of a hollow or Munroe charge of which the liner is a rounded cone of 120° whole angle, and it is possible that the design parameters for Misnay-Schardin charges could be arrived at by following the club rules for Munroe charges of that conformity.

(b) The depth or thickness of the charge from the dish or saucer to the initiator is the one remaining leading dimension, and this is governed by the rule that:

The line joining the initiator to the periphery of the dish or saucer should be tangential to the latter (see Fig. I) (3)

It is observed that this rule if strictly followed gives a fairly shallow charge, even if it is assumed that the tangential line should actually mark the inner extremity of the exploder, and not that of the initiating detonator. French munitions embodying the Misnay-Schardin principle are observed to be of somewhat greater depth than would be given by this rule.

(c) As shown in Fig. 1, the peripheral part of the rear of the charge can be shaped so that the exterior wall is roughly parallel to the aforesaid tangential line; this gives a saving in H.E. and gross weight but is not considered essential.

(d) The thickness of the dish or saucer, t in Figure 1, is partly governed by the rule that:

$$\text{Weight of high explosive} = \text{weight of dish or saucer, very approximately} \quad (4)$$

Here again, it is observed that at least two French munitions on this plan contain an amount of H.E. weighing twice as much as the dish or saucer. Another guide is the statement that a thickness of 12 mm. (say half an inch) is about the minimum for a dish that will endure being flung off without breaking up, but it is not altogether clear why this should be so; and it is merely put forward as a teaching of experience. The material used for the dish should be mild steel.

(e) A further minor rule is that the dish or saucer should not extend to the whole diameter of the charge; there should be a small annular margin, shown as m in Fig. 1. This reduces the chance of the dish or saucer being broken when it is flung off.

(f) Finally, experiments have shown that if the charge is exploded with the dish or saucer in initial contact with the target, the penetration performance is greatly reduced. In consequence, it is recommended that charges of this kind should be furniahed with a full diameter cover or "hat" with a height of about $\frac{1}{2}$D. This is shown in dotted line in the figure 1.

2. Choice of High Explosive

The French authorities do not use T.N.T. as a filling for Misnay-Schardin charges, alleging as the reason for this that their own supplies of T.N.T. contain impurities and are inclined to yield incomplete detonation. It may here be interpolated that incomplete detonation is much more likely to be a symptom of inefficient explodering than of impurity. The French authorities add, however, that straight T.N.T. of good quality should prove perfectly satisfactory in charges of this type. They themselves use the high explosive "melinite", which is a waxed picric acid; but it should be noted that nitrophenolic fillings such as this are not at all popular in British filling factories because of their tendency to form sensitive picrates with most of the common metals.

The French state that R.D.X./T.N.T. has too high a velocity of detonation to be suitable for Misnay-Schardin charges, and that if used it will shatter the dish or saucer. Their best results have been obtained with a mixture of T.N.T. 75%, R.D.X. 20%, and powdered aluminium 5%; and that being so it appears probable that lean Torpex would be equally satisfactory.

REFERENCES

1. Ordnance Board Proceeding Q.600, July, 1942.

2. B.I.O.S. Final Report No. 492, by C. A. Adams and H. L. Porter, March, 1946.

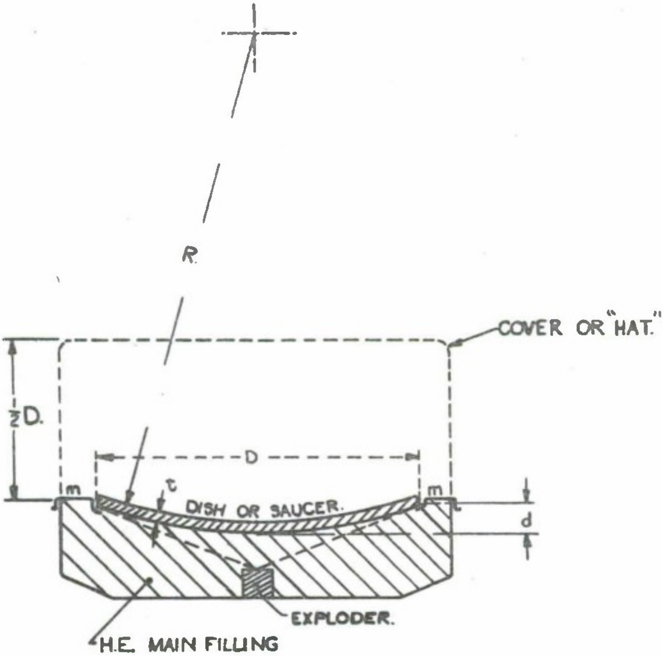
3. B.I.O.S. Final Report No. 1062, by H. L. Porter, September, 1946.

4. A.D.E. Report No. 10/50 "A Theoretical Treatment of the Misnay-Schardin Effect" by F. Chorlton, Armament Design Establishment, September, 1950.

5. "French Armament Research and Design (Land Service)" by P. Bethell, Armament Design Establishment, March, 1952.

FIG. 1.

DIAGRAM TO ILLUSTRATE THE DESIGN PARAMETERS FOR "MISNAY-SCHARDIN" CHARGES.



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